

SB

951

C3

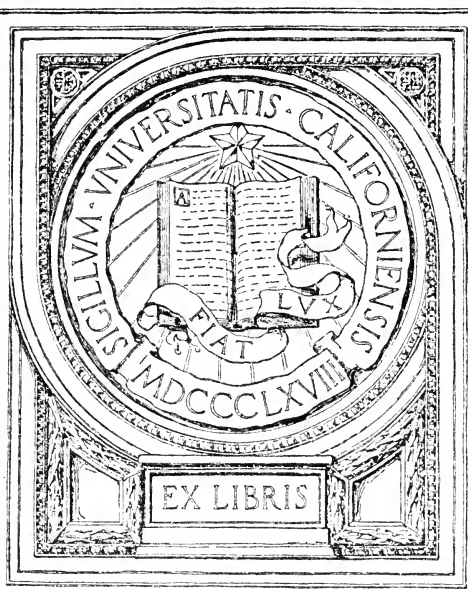
UC-NRLF



\$B 70 730

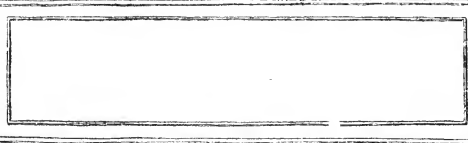
Fungi and Fungicides  
State Horticultural Commission

YC 60808



EX LIBRIS

*Marie. Sept.*



Gaylord Bros.  
Makers  
PAT. JAN. 21, 1908

a

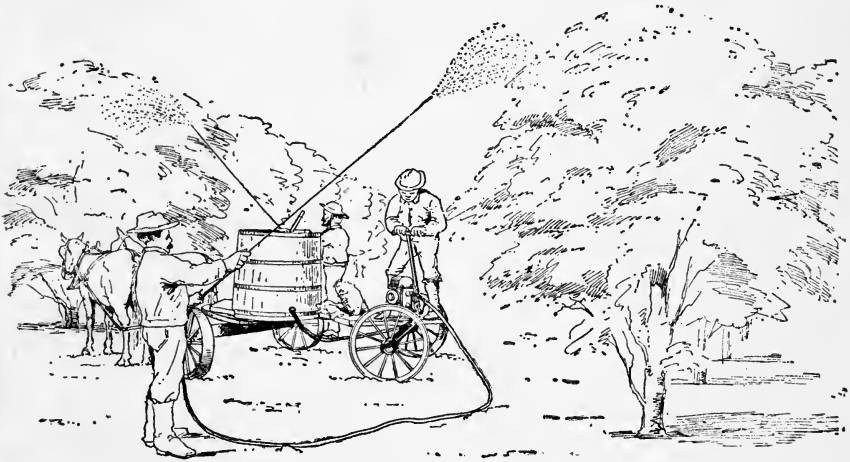
Calif

STATE HORTICULTURAL COMMISSION

ELLWOOD COOPER, Commissioner

STATE HORTICULTURAL  
LIBRARY,  
SACRAMENTO,  
CALIFORNIA

# FUNGI AND FUNGICIDES



W. W. SHANNON, - - - - Supt. State Printing

SACRAMENTO

W. W. SHANNON,

SUPT. STATE PRINTING

1905

518951  
C3

## CALIFORNIA STATE COMMISSION OF HORTICULTURE.

---

ELLWOOD COOPER .....Commissioner .....Santa Barbara.  
JOHN ISAAC .....Secretary.....San Francisco.  
ED. M. EHRHORN .....Deputy .....Mountain View.  
E. K. CARNES .....Assistant Deputy .....Riverside.  
O. E. BREMNER .....Second Assistant .....Santa Rosa.  
GERTRUDE BIRD .....Stenographer .....Sacramento.

---

### OFFICE:

ROOM 41, STATE CAPITOL, SACRAMENTO.

BRANCH OFFICE, ROOM 11, FERRY BUILDING, SAN FRANCISCO.

Main Lib  
Agric. Dept

U. S. GOVERNMENT  
PRINTING OFFICE

UNIVERSITY OF CALIFORNIA

## FUNGI AND FUNGICIDES.

Growing plants are liable to the attacks not only of insects, but also of parasitic fungi. The peculiar maladies known as fungous diseases are produced by the rapid development of the parasitic fungi. It is estimated that in the United States alone the annual loss from these minute vegetable organisms runs into millions of dollars.

Fungi belong to the so-called lower plants, among which are the toadstool, mushroom, molds, mildews, rusts, smuts, blights, etc. A fungus may attack only dead tissue or decaying matter, as is the case with mushrooms or toadstools, or it may attack only animal life, as is seen in the fungus which destroys the house fly and the chinch bug. But the most important class of parasitic fungi with which the fruit-grower has to deal are those which attack the live tissue of plant life—those which check the growth of trees, attack and spot fruit, and even cause an early decay or a total loss before the crop is harvested.

Fungi are plants, much the same as trees, grass, etc., the only difference being that they do not have the green coloring matter, or chlorophyll, of the latter. The seeds, called spores, are more simple and are exceedingly minute (microscopic). They are produced in numbers which appear almost incredible to those not versed on the subject.

Fungi are divided into two groups: the internal and the external. The internal fungi send their germ tubes into the skin of the leaf, fruit, branch, or root, and the branching threads (mycelium) develop entirely within the tissue of the host plant. This group includes some of our worst species, such as peach-leaf curl, anthracnose, brown rot, shothole fungus, and all the grain smuts.

The external fungi are surface feeders, their mycelium spreading over the surface of the fruit, leaf, or branch, as the case may be, and are easily controlled by the use of sprays. To this group belong the powdery mildews of the apple, grape, rose, gooseberry, etc.

It will be readily seen that quick action, perseverance, and good judgment on the part of the grower are necessary to obtain satisfactory results. Especially is this true of the internal fungi, which must be attacked before the germ-tube enters the tissue.

#### PEACH-LEAF CURL.

In some seasons this fungus is very severe, and on some varieties of peach more than on others. It can be easily recognized by the abnormal growth of the leaf, which becomes leathery, highly colored, and sometimes resembles a seed-pod more than a leaf.

In winter use the lime-sulphur-salt wash or the Bordeaux mixture (formula A).

Just as the buds are swelling use the Bordeaux mixture (formula B).

#### APPLE OR PEAR SCAB.

This is one of the most common diseases of pomaceous fruits the world over. It does not reduce the crop, nor does it seem to

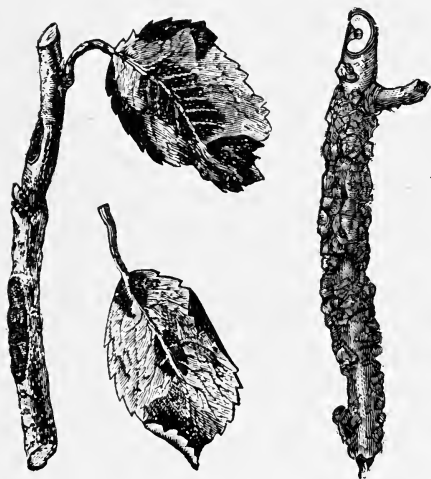


FIG. 1. The effect of the fungus on one- and two-year-old pear branches and leaves.

affect the vitality of the tree, but it injures the quality of the fruit, making it unsalable. The grower knows too well that a scabby or a deformed pear has no sale in the market or at the cannery, in fact is only fit for hog feed; therefore, the utmost vigilance and greatest care should be exercised in the application of remedies to check this disease. The first appearance of the scab is seen upon the new growth

and small fruit as a velvety spot. The disease is easily recognized, and if not soon checked the velvety spots on the fruit continue to spread until they have the appearance of black, scabby, corky blotches. As the pears grow, the development of the affected side is arrested, but the healthy side continues

to develop very fast and begins to twist or double over the affected side, making a very ugly looking, misshaped fruit.

Spray with the lime-sulphur-salt wash as late in winter as possible.

Spray with the Bordeaux mixture (formula A) while the buds are unfolding. If the season permits, a second and third spraying, ten days apart, using formula B, will prove beneficial.

### SHOTHOLE FUNGUS.

This disease has, of late, become very prevalent, attacking all the stone fruits, and has been especially destructive to the



FIG. 2. Appearance of the fungus on an apple.



FIG. 3. A blotch—enlarged.

apricot. It makes its appearance upon the leaves, forming reddish-brown spots, which, when mature, shrink from the surrounding tissue and are blown away, leaving the leaf perforated. When the fungus attacks the fruit, it first appears as minute red pimples, which are very often mistaken for scale insects. These soon develop and burst open at the top, the new spores escaping and spreading the disease. The old spot forms a scab, which spreads and joins others, and soon the surface becomes very rough, rendering the fruit unsalable.

Spray with the lime-sulphur-salt solution in winter, and use the Bordeaux mixture (formula B) just when the buds are swelling. If the lime-sulphur-salt remedy is not used, then the Bordeaux mixture (formula A) should be applied as early in the season as possible.

**BROWN ROT.**

The brown or fruit rot of stone fruits is known in but few localities in the State. Wherever this disease occurs, its presence is shown by the ashy gray spores on the surface of the fruit. Sometimes, where several fruits are clustered together, a small brown spot appears and rapidly spreads until the whole becomes shrunken, soft, and discolored. The interior

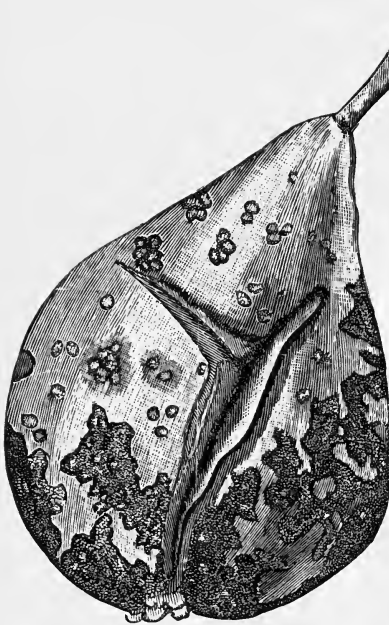


FIG. 5. Pear cracking.

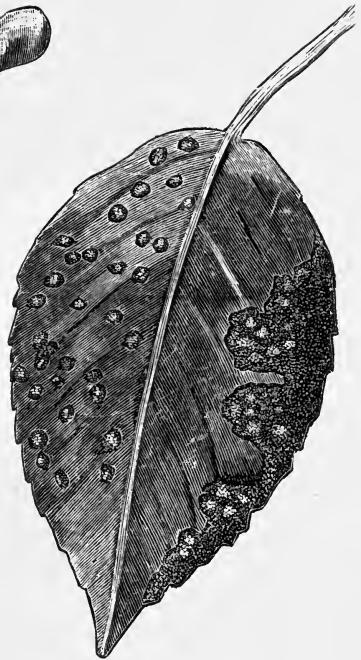


FIG. 6. Leaf blight.

of fruits which do not indicate much outward attack will show a brownish, rotten appearance when cut open.

Wherever the disease exists, care should be taken to gather all diseased fruit, generally known as mummied fruit, which may cling to the fruit spurs or fall to the ground, as the spores thereon will infect the next year's crop.

The same remedies as are used for pear scab will check this disease.



**POWDERY MILDEW OF APPLE, PEACH, AND OTHER TREES.**

During the summer months one may notice the leaves and new growth of fruit trees covered with a thick, white, felt-like covering. These are the mycelium of the powdery mildew fungus. This fungus belongs to the external group, the mycelium of which live on the outside of the plant and do not enter the tissue of the leaf. Early in the fall of the year the winter spores are developed and consist of very minute, round, black masses, which remain on the fallen leaves or twigs during the winter and from which start the next season's brood.

Use the ammoniacal solution of copper carbonate when the leaves first open, and in very bad cases repeat three or four times at intervals of fourteen days.

**BITTER ROT OF THE APPLE.**

This fungus has appeared in various apple districts. The time to spray for it is when it first makes its appearance. This disease can be easily recognized by the presence of small blackish pustules scattered over the surface of the apple. These are the fruiting spots of the fungus. The mycelium enter the pulpy tissue of the fruit and cause the rot to appear in little brown specks underneath the skin.

In very bad cases the first spraying should be followed by a second and third spraying at intervals of two weeks, using the ammoniacal copper carbonate solution.

**PRUNE-LEAF RUST.**

The leaves of the prune and other stone fruits are often attacked by reddish spots on the surface and yellowish-brown spots on the under side. Sometimes this attack is so severe as to cause the dropping of the foliage.

Spraying with the Bordeaux mixture (diluted formula) just after the buds start, and continued at intervals of ten or fourteen days during the growing season, will do much toward checking the fungus.

**PEAR BLIGHT.**

This disease, while not belonging to the group of fungous diseases on which we are treating, has become so important in this State and is doing such destructive work that allusion to

it in this connection is imperative. The pear blight is caused by a bacterium discovered by Prof. T. J. Burrill, of Illinois, and by him named *Bacillus amylovorus*. Its point of entry into the tree is usually through the blossoms, although in some cases it may find entry through wounds or abrasions in other portions. The whole of the pomaceous family, including apples, medlars, hawthorns, and quinces, is subject to attack, but the pear especially so, and the tenderer varieties, as the Bartlett, most of all. This disease has received marked attention from the Department of Agriculture at Washington, D. C., on account of the serious inroads it has made in the pear sections of the East, and Prof. M. B. Waite has made an especial study of it for many years past. In response to an invitation from the Commission of Horticulture last fall, Professor Waite was detailed to study the disease in California, and under his direction a series of experiments has been made. So far the only method of fighting this disease, and the one which has been in vogue for many years in the East, is to cut out the affected portions of the tree well below the point of infection. An important feature of this work is the disinfection of the tools used in the cutting-out process. Unless this is properly done, the tools themselves may become the medium of distribution of the disease. Professor Waite is positive in his assertion that if the work of cutting out the infected portions is conscientiously and generally performed, there is little danger to be apprehended from this disease.

### GOOSEBERRY MILDEW.

In some sections of the State it is almost impossible to raise good gooseberries, on account of mildew. This fungus appears in the spring upon the newly developed leaves and buds, and later appears as a white powdery mass, caused by the numerous summer spores. Later in the season it attacks the young berries, which are rendered unmarketable, or in very bad cases the entire crop drops prematurely.

Spray with a solution of potassium sulphide when the leaves commence unfolding, and repeat in from two to three weeks.

During the winter remove all old canes and spray with the Bordeaux mixture (formula B).

**ANTHRACNOSE.****Affecting the Raspberry, Blackberry, and Rose.**

This fungus appears as small reddish-purple spots upon the canes and leaves in the spring and early summer. These spots are scattered over the surface of the new growth near the ground, and have a distinct purplish margin, representing the

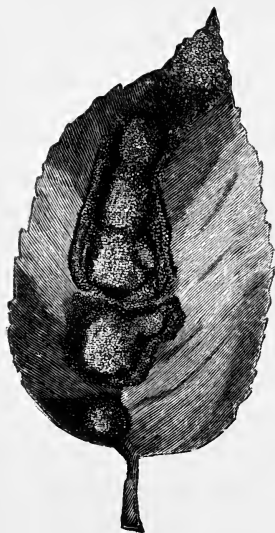


FIG. 7. Rose leaf black spot.



FIG. 8. Strawberry leaf blight.

division between the healthy and diseased tissue. As the season advances these spots increase in size, and, merging with others, form irregular, longitudinal blotches, which in very bad cases girdle the cane.

Use the Bordeaux mixture (diluted formula) before the leaves open, and repeat at intervals of two weeks, spraying the canes which are starting out of the ground.

Removing the old canes and burning them will greatly reduce the disease.

**ORANGE RUST.**

This disease is familiar to most growers of blackberries and raspberries. The disease becomes noticeable soon after the leaves expand in the spring, turning them a golden color. Soon small orange-colored spores appear on the surface of the leaves. From these spores develop the winter spores, which spread to the growing shoots just starting from the ground and remain there until spring, to again infest the plant.

All diseased canes should be cut and burned whenever discovered. Spraying with the ammoniacal copper carbonate solution will prove helpful, if applied on the winter spores.

**ONION MILDEW.**

California, with her large seed gardens, has suffered very much from onion mildew in abnormal seasons. The seed onions carry the hibernating spores, which soon attack the new growth in spring. The disease is easily recognized by the grayish, velvety coating on the new tops and blossom stalks. If the land is to be used again for onions, all tops remaining in the field after the seed has been collected should be burned, and should never be plowed under, as is generally practiced. Rotation of crops is much the safer preventive.

Wherever practicable, the ammoniacal copper carbonate solution can be used to good advantage.

**BEAN ANTHRACNOSE.**

Young bean pods are often attacked by this disease, some varieties more than others. It can be readily recognized by small reddish-brown spots, slightly depressed, on the surface of the pods. These spots increase in size rather rapidly and, connecting with others, form long discolored blotches. The pod becomes stunted and the young beans are generally shriveled. Seed from diseased plants should never be used for planting, as the spores upon them will first infest the young growing plants and from them spread to the newly developed pods.

Soaking the seed in a diluted ammoniacal copper carbonate solution before planting is a sure preventive. Spraying with the Bordeaux mixture (diluted formula) has given good results. Burning the old plants after harvest and making a clean culture in general have much to do with a successful checking of the fungus.

### **TOMATO ROT.**

When the fruit of the tomato is about half grown it is subject to the attack of rot. The first appearance of this disease is a small blackish-brown spot, which rapidly increases in size. The underlying tissues of the fruit are destroyed by the fungous threads, and the side of the fruit affected becomes flattened.

Wherever this disease appears it can be checked to a certain degree by thinning out the plants and allowing more sunshine to reach the fruit.

Spraying with the Bordeaux mixture (formula B) when the fruit is first forming will often check the fungus.

### **POTATO BLIGHT OR ROT.**

This disease attacks the leaves, stems, and tubers. It is first noticed upon the leaves by the sudden appearance of brownish or blackish areas, which soon become soft and foul-smelling. This disease generally occurs in our coast counties and other sections where plenty of moisture exists. The presence of a few successive hot, dry days in these districts checks its rapid development.

Spraying with the Bordeaux mixture (formula B) when the growth just appears above ground, especially in sections where this fungus is known to exist, is very important. Affected potatoes should never be used for seed, and all vines remaining after harvest should be burned.

### **POTATO SCAB.**

This is a very widespread disease, and is readily recognized by the dark, rough surface which occurs in spots all over the tubers.

This disease can be successfully controlled by treating the seed potatoes in a solution of corrosive sublimate. Immerse them for a couple of hours in the liquid, and after their removal allow them to dry before cutting them for planting. All potatoes thus treated, if not planted, must be destroyed, as there is sufficient poison on them to make them dangerous to use as food or to feed to stock.

### ROOT KNOT.

No fungous disease is easier recognized than this. The very prominent black or brown wart-like excrescences upon the trunk and roots, below ground, of all stone-fruit trees, readily reveal its presence.

Cut away the knot in the fall or winter and allow the wound to dry, then with a swab apply a saturated solution of bluestone to the affected part.\* This may be repeated two or more times as long as the trees remain dormant. Never apply it to the tree when the sap is flowing. After the knots have been treated the soil is thrown back again, covering the exposed roots. The Bordeaux mixture (formula A), applied in a similar way, has also given good results. Instead of removing very large knots it is better to bore an inch hole to the center of the knot and fill this with either of the above solutions, which will permeate the tissues of the knot and cause it to drop off after a few months.

### OLIVE KNOT.

One of the most serious diseases of the olive tree, in a few counties of California, is the olive knot, or tuberculosis of the olive, as it is sometimes called, which, like the pear blight, is a bacterial and not a fungous disease. The tubercles, or knots, which give this disease its name, are found singly and in rows on branches of all ages. The bacteria which cause the disease form a colony in the tissue of the sap-wood, which appears like a small, transparent spot. This spot, when seen under a high-power microscope, is found to consist of many bacteria. From this spot soon develop, through different stages, the tubercle knots. On the trunks and larger branches the knots generally attain a large size.

The diseased parts of affected trees should be carefully removed and immediately burned. All wounds made by the removal of the disease should be dressed with an antiseptic paint.

Cuttings from diseased trees should never be used for propagating purposes.

---

\*A saturated solution of bluestone is all that water will dissolve. But it is advisable to leave some undissolved bluestone in the bottom of the vessel, as this will indicate that the water has taken up all the bluestone it can.



FIG. 9. Olive knot.

**POWDERY MILDEW OF THE ROSE.**

This disease is too well known to the lovers of tea roses to need much description. It is the white powdery fungus which is so often seen on the new growth, leaves, and buds of the rose bush, marring the beauty and blasting the buds of many of our choicest varieties.

If taken in hand when it first makes its appearance on the new growth, dusting with sublimed sulphur will check its spread. Spraying with the Bordeaux mixture (diluted formula), just before the new growth starts, will prevent its appearance.



FIG. 10. Rose rust.

**ROSE RUST.**

This disease confines itself to the hybrid perpetual roses, and is easily recognized by the orange-colored spots on the under side of the leaves, which in very bad cases become entirely covered.

After pruning rose bushes in the fall, they should be thoroughly sprayed with the Bordeaux mixture (formula B). All leaves should be gathered and burned, as these contain the winter spores. If the fungus was very severe during the season, spraying again in the spring, just when the growth starts, with the ammoniacal copper carbonate solution or the Eau Celeste solution, will greatly aid in checking the trouble.



## FORMULAS.

## LIME, SULPHUR AND SALT.

Unslaked lime.....	40 pounds.
Sulphur.....	20 pounds.
Salt.....	15 pounds.
Water.....	60 gallons.

Place 10 pounds of lime and 20 pounds of sulphur in a boiler with 20 gallons of water, and boil over a brisk fire for not less than one hour and a half, or until the sulphur is thoroughly dissolved. When this takes place, the mixture will be of an amber color. Next place in a cask 30 pounds of unslaked lime, pouring over it enough *hot* water to thoroughly slake it; and while it is boiling, add the 15 pounds of salt. When this is dissolved, add to the lime and sulphur in the boiler, and cook for half an hour longer, when the necessary amount of water to make the 60 gallons should be added.

A much easier method of preparing the above wash is as follows: Make the sulphur into a thin paste with hot water; place the unslaked lime in a tight barrel and add the sulphur paste and from 10 to 15 gallons of boiling water. Cover the barrel with sacks and a wooden cover and let it stand. After the violent boiling has subsided, the mixture must be stirred thoroughly until all indications of boiling stop. Then add the salt and enough hot water to be able to strain the mixture into the spray tanks, and add the required quantity of boiling water.

## BORDEAUX MIXTURE.

## Formula A.

Copper sulphate (bluestone).....	8 pounds.
Quicklime.....	10 pounds.
Water.....	50 gallons.

## Formula B.

Copper sulphate (bluestone).....	5 pounds.
Quicklime.....	6 pounds.
Water.....	50 gallons.

## Diluted Formula.

Copper sulphate (bluestone).....	2 pounds.
Quicklime.....	2 pounds.
Water.....	30 gallons.

Dissolve the copper sulphate in a barrel containing 10 to 12 gallons of water. Slake the quicklime and thin it to a creamy

whitewash. Pour the whitewash very slowly through a wire screen into the copper solution. Stir the mixture thoroughly, and add enough water to make 50 gallons in all. Stir occasionally while applying as a spray to the trees.

In the preparation of the Bordeaux mixture it is necessary that the ingredients should be mixed in a wooden vessel. If an iron one is used the copper will go to the iron and the effect of the spray be largely neutralized.

Apply the wash cold and as soon as possible after it is prepared. *Never allow it to stand over night.*

#### AMMONIACAL COPPER CARBONATE SOLUTION.

Copper carbonate .....	6 ounces.
Ammonia .....	3 pints.
Water .....	50 gallons.

Dissolve the copper carbonate in the ammonia and add the water.

*Caution:* Use no more ammonia than is required to dissolve the copper carbonate. Ammonia is variable in strength, and the amount required must be tested in practice.

#### POTASSIUM SULPHIDE SOLUTION.

Potassium sulphide.....	1 ounce.
Hot water.....	2 gallons.

Dissolve the potassium in hot water, and use as a spray when cold.

#### EAU CELESTE SOLUTION.

Copper sulphate.....	2 pounds.
Ammonia .....	1 quart.
Water .....	50 gallons.

Dissolve the copper sulphate in 6 gallons of water, using a wooden vessel, then add one quart of ammonia and sufficient water to make 50 gallons of wash.

#### CORROSIVE SUBLIMATE SOLUTION.

Corrosive sublimate.....	2½ ounces.
Hot water.....	2 gallons.

Dissolve the corrosive sublimate in the water, let it stand for about 10 hours, and then add sufficient water to make 15 gallons of spray.



